

## Canadian Urban Wage Gaps and Their Determinants

It is well-documented that urban development has significant effects on local labor markets and the wage distribution across cities. Workers in larger cities have higher levels of productivity and earn wages on average higher than their counterparts in relatively smaller cities (Glaeser, 2008; Moretti, 2010; Baum-Snow & Pavan, 2011; Anderson, Klaesson, & Larsson, 2013; Fortin & Lemieux, 2014). For example, the average nominal wage of workers in Toronto was 3% higher relative to the workers in Winnipeg in 1981, and the gap has expanded over time reaching 15% by 2006<sup>1</sup>.

Seeking higher wages, workers move to high-pay cities. However, the location decision of individuals affects not only the migrant's welfare, but also others'. The channel of impact is through the cost of living. Attracted by higher wages, the migration of workers puts pressure on the demand for housing and such local goods and services as restaurants, healthcare, insurance etc. Therefore, new workers as well as the current residents experience an increase in their cost of living.

There exist different alternative explanations and hypotheses for urban wage premiums/gaps in the literature. Higher wages in some cities relative to others can be attributed to the discovery of natural resources (like oil in Alberta, Saskatchewan, and Newfoundland and Labrador). Resource extraction acts as a local labor demand shock which bids up the wages, and thereby higher average wages relative to non-resource areas (Fortin & Lemieux, 2014).

Spatial sorting can be another source of the urban wage premium according to which workers with higher ability tend to sort themselves into urban areas. The intuition is that cities are centers of consumption which are of interest to workers with higher ability. Alternatively, cities are able to speed up the flow of information which is valuable to workers with higher human capital. Thus, workers with higher ability tend to locate in urban regions to benefit from human capital spillover. Moreover, as shown in Moretti 2004, the social return to human capital is larger in bigger cities which results in higher investment in human capital as well as an increase in the flow of skilled workers into bigger cities. (Glaeser, 2001; Moretti 2004; Combes et al, 2008; Mion and Naticchioni, 2009; Matano & Naticchioni, 2011; Moretti, 2013; Anderson, Klaesson, & Larsson, 2013).

Moreover, Wheaton & Lewis (2002) argue that urbanization and localization economies are the likely determinants of urban wage gaps where urbanization economies look at the size of the cities (concentration of economic factors of production), while localization looks at the degree of factor specialization. To test this hypothesis, they build two indices of occupation/industry specialization and occupation/industry concentration to measure the localization and urbanization economies, respectively. They further conclude that localization economies are the main determinant of wage gaps.

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<sup>1</sup> Authors estimations based on Public Use Micro File from Statistic Canada, Census of Population 1981 and 2006.

Yet another explanation for urban wage premium is the hypothesis of agglomeration economies. A cluster of firms in one location generates knowledge spillovers, proximity to providers of non-tradable and intermediate goods which can also be used as inputs to production of different sectors of the economy, and higher labor productivity due to thicker labor markets. The direct implication of agglomeration economies is that locations with a cluster of firms are more productive and therefore pay higher wages. This means that if a worker enters into such labor market, s/he would be immediately receiving a wage gain, and if a worker leaves the city, then s/he would be immediately receiving wage loss, referred to as wage level effect (Glaeser & Mare, 2001).

In addition to the wage level effect, Glaeser & Mare (2001) claim that the urban wage premium can be due to a faster rate of human-capital accumulation in cities. Their argument indicates that cities provide opportunities which enable workers to learn and accumulate human capital at a faster rate. This in turn results in a faster growth in their wages. Put differently, if a worker lives in a productive city for ten years, his/her most recent wage would be higher than if s/he had otherwise lived in a less productive city. In this sense, even if a worker leaves the city, s/he would not experience an immediate loss in his/her wage. This notion is known as wage growth effect.

A new study by Beaudry, Green and Sand (2012) has also attempted to clarify the wage gaps between cities. They believe that industrial composition of a city matters when it comes to wage differences. A city with lots of high pay jobs in a sector not only affects the wages in that sector directly, but also the wages in other sectors through general equilibrium in a search and bargaining framework. In other words, an industrial shift toward high paying jobs in a sector can act as an outside option to the workers in other sectors and enhance their bargaining power, thereby increasing their wages.

In a recent study, Baum-Snow & Pavan (2011) develop an on-the-job-search model, which incorporates latent ability, search frictions, firm-worker match quality, human capital accumulation and endogenous migration between small, medium and large cities. They categorize the locations into three types of small, medium and large, because they believe that the persistence of city-size productivity (wage) gaps is not monotonic in city size.

Using National Longitudinal Survey of Youth (NLSY) data, the estimated parameters from the model enable the authors to break down the city-size wage gap into four components 1) sorting on unobserved ability across cities, 2) differences in search frictions, unemployment benefits and the distributions of the firm-worker match component of wages across cities and abilities, 3) variation in wage level effects across cities and abilities and 4) variation in returns to experience across cities and abilities.

The results from counterfactual simulation shed light on the relative importance of the components. Variation in wage intercepts and returns to experience across location type account

for almost the entire overall city-size wage gaps for both high-school and college graduates, while differences across locations in job offer arrival rates and dispersion of the firm-worker match quality distribution do not significantly contribute to observed wage gaps. In particular, the decomposition of log wages over first 15 years of experience indicates that within job wage growth generates more of the city-size wage gaps than between job wage growth. More precisely, wage level effects account for about 66% of small-medium city size wage gap for college graduates (with the rest explained by returns to experience) and almost the entire gap for high school graduates. As with the small-large city size wage gap, experience effects make up 57% and 78% of the gap for college graduates and high school graduates, respectively.

Additionally, Abdel-Rahman and Fujita (1990) develop a model to show that industrial agglomeration economies are endogenous and their origins come from the specialized local service producers. Put differently, they believe that increasing returns to service industry (non-tradable sector) and the desire of traded-good industry to employ a variety of intermediate services may provide the basic sources of industrial agglomeration in the city. That is, the larger the variety of intermediate services, the higher is the productivity of the traded sector.

Furthermore Moretti (2010) argues that the creation or attracting new businesses in the tradable sector has local multiplier effects. That is, when a local economy attracts or creates a new job in the tradable sector, additional jobs are automatically created in the non-tradable sector mainly through increased demand for local goods and services. The idea is that when the number of workers and the equilibrium wages increase in a city, the demand for local products rises as well. The magnitude of this multiplier effect varies across industries and workers. Adding one additional skilled worker in the tradable sector can generate 2.5 jobs in non-tradable sector while the corresponding figure for unskilled worker is one. In addition, the multiplier effect is the largest when high-tech industries are added to the economy.

Although many alternative explanations have been proposed to address the question of urban wage gaps, there still seems to be some shortage regarding the origins of such gaps and how they evolve. To understand the process of wage formation more clearly, in a simple framework I will show how wages are generated, and how they grow. Next I will apply this framework to data and test its implications.

Assume a small economy in which workers supply their unit of labor, produce a mass of tradable goods and services,  $X$ , which are sold either in domestic market or world market, and are paid the marginal value of their product ( $W_X = P_X \cdot MPL_X$ ). At the same time, these workers need local goods and services,  $y$  and spend part of their wages on such local products. That is, some workers are required to produce local goods and services and are paid their marginal value of their product ( $W_y = P_y \cdot MPL_y$ ). This is how the initial level of wages is determined in tradable and non-tradable sector of the economy.

Now we need to know how the wages evolve over time. In the tradable sector assuming that the prices are given at the world market, the only way for wages to rise is an increase in the productivity of labor embedded in the goods produced. Since workers are heterogeneous, it is expected for the economy to have workers with different levels of marginal productivity; and the variety of marginal productivity is reflected by wage differences based on  $W=P \cdot MPL$ . Put differently, an economy with a large number of high ability workers (skilled workers) is expected to experience high wages. At the same time, high-wage earners desire to consume more and drive up the demand for local goods and services. Thus, new local jobs, as well as wider variety of local goods and services will be created and wages in this sector will rise too. I call this situation income spillover effect because the presence of people with high incomes benefits the rest of the economy through general equilibrium.

Moreover, wider variety of local goods and services can generate consumption and production amenities<sup>2</sup> to the economy. These amenities themselves can attract other workers, in particular skilled workers, and new businesses to the city and generate a higher level of wages through enhanced marginal productivity of labor. Yet again, the rise in the number of workers with high wages will generate more income spillover from high-wage earners to locally services producers through general equilibrium which results in higher wages for the rest of economy.

This process feeds on itself as a circle until the economy reaches its maximum level of production possibility. Although higher wages attract workers from other cities, they don't necessarily equalize across locations. This is because labor is not fully mobile. Furthermore, even in very mobile labor markets, mobility is not uniform across workers. For instance it is well-known that skilled-workers are more mobile than unskilled. There are many good reasons (such as housing costs, congestion externalities, idiosyncratic behavior, search frictions, and disproportionate unemployment benefits between skilled and unskilled workers) to accept why this assumption is logical.

The framework above implies that the presence of skilled workers in an economy is critical to not only the growth of wages but also the advancement of a city. A city with large number of skilled workers (skilled city hereafter) is able to generate, directly and indirectly, a higher level of incomes for its workers; and higher level of incomes will attract individuals from other locations which in turn leads to urban development.

The idea above has a great deal of support in economics literature. In macro- and urban-economic literature (in the context of knowledge spillover and agglomeration economies respectively) it is well documented that a cluster of productive and skilled workers affect the aggregate productivity through knowledge spillover and creation of new ideas and jobs. Thus,

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<sup>2</sup> Consumption amenities are such characteristics of regions as good weather, proximity to coast and good infrastructure which increase the quality of life.

Production amenities are such characteristics of regions as agglomeration economy, technology and natural resources which lowers the cost of production.

enhanced productivity directly drives up the wages for skilled workers (Acemoglu 1996, Moretti 2004, Glaeser and Saiz 2004).

Moreover, the equilibrium rate of return to the human capital of a worker increases with the average human capital of the workforce (Acemoglu 1996). That is, any worker in such economy benefit from pecuniary externalities. This indirect effect is known as wage level effect in urban economic literature (Glaeser & Mare, 2001). Other than that, skilled workers are able to generate additional pecuniary externalities through general equilibrium which is called income spillover effect as stated in the framework above. This effect seems to be specific to non-tradable sector because it is generated through rising demand for local goods and services. One goal of this paper is to test if the income spillovers exist? And if so, what is the magnitude of such effect both in static and dynamic settings.

To better grasp the role of skilled workers, I also borrow from economics of immigration, in particular the immigration of skilled workers. Even though these studies mainly aim at the policy implications for immigration, part of their findings are valuable to my work because they flag the innovative and entrepreneurial abilities of skilled immigrants (workers) in an economy.

In her well-cited paper, Annalee Saxenian (Saxenian 1999) conducts a study exploring the economic contributions of skilled immigrants to the economy of Silicon Valley. She argues that the impact of foreign-born engineers on regional job and wealth creation in Silicon Valley is striking. Specifically the focus is on Chinese and Indian engineers most of whom arrived in the United States after 1970. While skilled immigrants take up only 33% of the engineering workforce by 1998, she demonstrates that roughly 25% of the engineering and technology startups are run by Chinese and Indian engineers. The entrepreneurial contribution of these immigrants goes even beyond Silicon Valley. These Chinese and Indian immigrant engineers are simultaneously building professional and economic ties back to their home countries to start businesses there.

In addition, Wadhwa et.al. (2008) explore the educational attainment of career trajectories of skilled immigrants. The research confirms that advanced education in STEM fields (science, technology, engineering, and mathematics) is correlated with high rates of entrepreneurship and innovation among both U.S-borne and foreign-born skilled workers. To understand this relationship, the study looks at a large sample of all engineering and technology firms founded in U.S from 1995 to 2005. Their work is actually an expansion and update of Saxenian's work. The study supports Saxenian's findings, and further finds that the trend Saxenian had documented with respect to the job-creation characteristic of skilled immigrants is not limited only to Silicon Valley but also works but also for the whole country.

Now that the skilled workers are vital to the growth of a city, the next question arises as to what influences the location decision of skilled individuals. Theoretically, several factors contribute to

the location choice of workers, which can be categorized into production amenities and consumption amenities.

One factor is the job opportunities for workers with different skills. That is, individuals locate themselves where the jobs are. For instance, a petroleum engineer is most likely to settle down in Alberta or Saskatchewan where oil extraction takes place. In such traditional industry, natural resources are the determinants of individual's location. Specialization and concentration are additional elements to the location question of skilled workers. This is specifically applicable to innovative industries. A computer programmer, for instance, prefers to work in cities where high-tech industries are concentrated. This is because it is much easier for computer programmers to match with their employers as the labor market is thicker (Moretti 2012).

In the consumption amenity context, workers, in particular skilled workers, care about facilities provided by cities. Glaeser et al (2001) argue that "as firms become more mobile, the success of cities hinges more and more on cities' role as centers of consumption". Empirically they find that "high amenity cities have grown faster than low amenity cities". They claim that faster growth in housing prices relative to nominal wages is an indicative of increasing demand for cities for reasons beyond rising wages.

Additionally, Moretti (2013) shows that skilled workers are increasingly locating in expensive cities. This becomes more informative when they find that the real wage gap between skilled and unskilled workers is relatively smaller than the nominal wage gap. Put differently, despite the fact that skilled workers are experiencing higher cost of living, they are still willing to stay in such expensive cities. In the context of revealed preferences, it is conveying that cities are providing the skilled with higher level of consumption amenities.

That being said, the second goal of this paper is to identify the location choice of skilled individuals. Understanding the underlying factors helps to learn how wages can grow and how the inter-urban wage inequalities expand. With respect to normative implications, it directs the policy makers to adopt appropriate policies in line with urban growth, whereby increasing the welfare level of their residents.

### **Econometric Methodology:**

Even though it is widely accepted that spatial sorting of skilled workers has significant effect on wage levels of a city, at first in a simple OLS regression I will show that wages and the skill composition of workforce are correlated across Canadian Metropolitan Areas (CMAs). Two alternative specifications can be utilized so as to illustrate the relevance of skilled workers.

$$1: \log W_{ijkt} = \alpha X + \beta_{jt} + \gamma_{kt} + \mu S_{jt} + \varepsilon_{ijkt}$$

$$2: w_{jt} = a + \lambda s_{jt} + e_{jt}$$

where  $W_{ijkt}$  is the wage of worker  $i$  in city  $j$  and industry  $k$  at time  $t$ .  $X$  is a vector of worker characteristics which basically are education and experience.  $\beta_{jt}$  is area-year fixed effects.  $\gamma_{kt}$  is industry-year fixed effects.  $S_{jt}$  is the share of skilled people in the workforce of city  $j$  at time  $t$  and  $\varepsilon_{ijkt}$  is an i.i.d error term. In the second alternative,  $w_j$  is the average wage growth in city  $j$  and  $s_j$  is the growth in the number of skilled workers.

Next step will be an attempt to quantify the spillover effect both in static and dynamic terms. Since the purpose is to determine to what degree the presence of skilled workers influences the wages of local good producers, following literature the dependent variable is the wages of service sector. Therefore the econometric specification is as follows:

$$3: \log W_{ijkt}^y = \alpha^y X^y + \theta_{ct} + \mu^y S_{jt} + e_{ijkt}$$

where  $W_{ijkt}^y$  is the wage level of individuals in local sector at time  $t$  in city  $j$ ,  $X^y$  is the worker characteristics in local sector,  $\theta_{ct}$  is the occupation fixed effects, The coefficient of interest here is  $\mu^y$  which is supposed to measure the income spillover effect. The bigger this effect, the more wages in local sector are expected to differ across cities.

To accomplish the second goal, we need to first identify what factors are affecting the location choice of skilled workers. As stated above, higher quality of life in a city is an attraction force to skilled individuals. To capture this effect I follow Albouy et al 2013. They argue that in a hedonic framework, willingness to pay for cost of living is representative of quality of life. That is, despite the high cost of living in expensive cities, individuals still stay in the city and enjoy the consumption amenities provided by the city. The same concept has been used by Glaeser (2001) and Moretti (2013).

In addition to consumption amenity, Production amenities play role in location question. Job opportunities and concentration of jobs are also other factors that skilled workers take into account when deciding where to live. To capture these effects I take advantage of employment rate and concentration/specialization index. To build the concentration and specialization indices I follow what Wheaton and Lewis (2002) propose. Industry concentration is computed as the number of workers in a city/industry divided by the total national workers in the same industry. Industry specialization is constructed as the number of workers in a city/industry divided by the total labor force of the city.

Eventually, the following specification is reached:

$$4: \log N_{jkt} = \alpha^z Z_{jkt} + E_{jt} + Q_{jt} + \eta_{jt} + \xi_{jkt}$$

where  $N_{jkt}$  is the number of skilled workers in city  $j$ , industry  $k$  at time  $t$ ;  $Z_{jkt}$  is the vector of industry concentration and specialization;  $\alpha^z$  is the vector of coefficients which captures the effect of specialization and concentration;  $E_{jt}$  stands for employment rate;  $Q_{jt}$  represents quality of life in city  $j$  and time  $t$ ; and finally  $\xi_{jkt}$  is an i.i.d error term.  $\eta_{jt}$  is to capture the area-year fixed effects.



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